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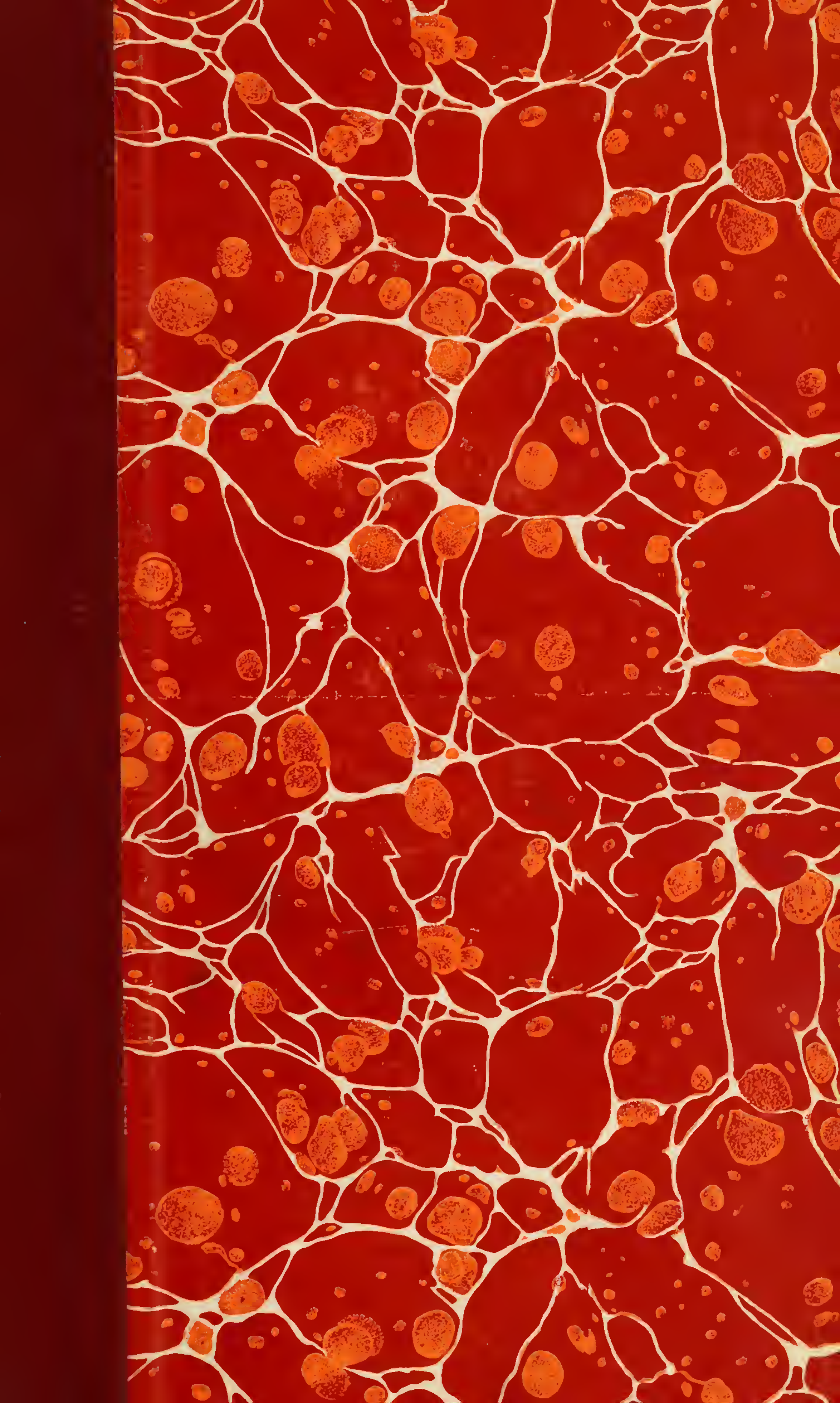

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TWENTY-SECOND ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE.

1906.

STATE OF MAINE.
1907.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

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Welton M. Munson	
Gilbert M. Gowell	
Edith M. Patch	
Warner J. Morse	

THE STATION STAFF.

Charles D. Woods	*Director*
James M. Bartlett	*Chemists*
Lucius H. Merrill	
Herman H. Hanson	
†Lewis I. Nurenberg	
*Arthur C. Whittier	
‡Joanna C. Colcord	
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Pomologist*
Gilbert M. Gowell	*Poultry Investigations*
Walter Anderson	
Edith M. Patch	*Entomologist*
*Warner J. Morse	*Vegetable Pathologist*
*Royden L. Hammond	*Seed Analyst and Photographer*
Annie M. Snow	*Clerk and Stenographer to the Director*
‡Blanche F. Pooler	*Stenographer*
Henry A. Millett	*Meteorological Observer and Janitor*

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* Appointed July 1, 1906.
† Resigned July 1, 1906.
‡ Appointed Sept. 1, 1906.

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The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

ANNOUNCEMENTS.

THE AIM OF THE STATION.

Every citizen of Maine concerned in agriculture has the right to apply to the Station for any assistance that comes within its province. It is the wish of the Trustees and Station Council that the Station be as widely useful as its resources will permit.

In addition to its work of investigation, the Station is prepared to make chemical analyses of fertilizers, feeding stuffs, dairy products and other agricultural materials; to test seeds and creamery glassware; to identify grasses, weeds, injurious fungi and insects, etc.; and to give information on agricultural matters of interest and advantage to the citizens of the State.

All work proper to the Experiment Station and of public benefit will be done without charge. Work for the private use of individuals is charged for at the actual cost to the Station. The Station offers to do this work only as a matter of accommodation. Under no condition will the Station undertake analyses, the results of which cannot be published, if they prove of general interest.

INSPECTIONS.

The execution of the laws regulating the sale of food, commercial fertilizers, concentrated commercial feeding stuffs, and agricultural seeds, and the inspection of chemical glassware used by creameries is entrusted to the Director of the Station. The Station takes pains to obtain for analysis samples of all brands of fertilizers and feeding stuffs coming under the law. It also draws samples of agricultural seeds and foods in the hands of dealers. The co-operation of dealers and consumers is, however, essential for the full and timely protection of their interests.

Foods. Dealers and consumers are invited to send by prepaid express original and unbroken packages of food materials on sale in Maine of whose purity they are for any reasons suspicious. As prompt free analysis will be made of such samples as circumstances will allow.

Feeding Stuffs. The Station will promptly analyze samples of feeding stuffs sold in Maine taken in accordance with directions which will be furnished on application. The results will be reported without charge to interested parties. This applies to dealers and consumers alike.

Commercial Fertilizers. It is difficult to draw accurate samples of commercial fertilizers. On this account it is only in rare instances that the Station undertakes analyses of fertilizers other than the samples collected by its representatives. In case there is special reason for an examination, the Station invites correspondence on the subject.

Agricultural Seeds. Samples of agricultural seeds on sale in Maine, taken in accordance with directions which can be obtained on application to the Station, will be examined as promptly as possible and the results reported free of charge.

In all cases samples should be accompanied by a full description of the goods, including the name and address of the dealer and the sender. Small samples other than liquids can be forwarded by mail. Others should be forwarded by express, charges prepaid.

STATION PUBLICATIONS.

The station publishes several bulletins each year, covering in detail its expenses, operations, investigations and results. The bulletins are mailed free to all citizens who request them. The annual report is made up of the bulletins issued during the year.

CORRESPONDENCE.

As far as practicable, letters are answered the day they are received. Letters sent to individual officers are liable to remain unanswered, in case the officer addressed is absent. All communications should, therefore, be addressed to the

Agricultural Experiment Station,
Orono, Maine.

The post-office, railroad station, freight, express and telegraph address is Orono, Maine. Visitors to the Station can take the electric cars at Bangor and Old Town.

The Station is connected by telephone.

HISTORICAL NOTES FOR 1906.

THE ADAMS ACT.

The Adams Act, which provides ultimately for the increased endowment of all the Hatch Experiment Stations by $15,000 per annum, was approved by the President March 16, 1906. The amount available for the fiscal year 1905-6 was $5000. The amount for the current fiscal year is $7000. This fund can be used only for "original investigations and experiments" and is not available for the general maintenance of the Experiment Station.

At the April meeting of the Experiment Station Council, it was decided to devote the Adams fund for the present to the following lines of work,—studies upon the nutrition of man; investigations of orchard problems; a study of plant diseases; and problems in breeding.

CHANGES IN STAFF.

As a result of the Adams Act, it became possible to change the appoinments of certain Station officers that have had part College and part Station work, so that their whole time can be given to Experiment Station work.

Mr. L. H. Merrill, formerly chemist to the Station and Professor of Biological Chemsitry in the University, now devotes his whole time to the Nutrition Investigations.

Dr. W. M. Munson, formerly Professor of Horticulture in the College of Agriculture, and Horticulturist to the Experiment Station, has been appointed Pomologist to the Station and now devotes his whole time to investigations relating to the orchard interests of the State.

Mr. W. J. Morse, B. S., University of Vermont, 1898, assistant in botany at the Vermont Experiment Station since 1901, has been appointed Vegetable Pathologist and assumed his duties July 1. His work is the study of the plant diseases of Maine.

Mr. L. I. Nurenburg resigned his position as assistant chemist in the Nurtition Investigations and Miss J. C. Colcord, B. S., in Chemistry, University of Maine 1906, has been appointed his successor.

Mr. A. C. Whitney, B. S. in Chemistry, University of Maine, 1905, was appointed July 1, assistant chemist in the inspection work.

January 1, Miss B. G. Leeds resigned her position as Photographer and Seed Analyst in the Station, and Mr. Roydon L. Hammond has been appointed her successor.

HOLMES HALL.

As described in the annual report for 1905, a north wing was added to Holmes Hall for the use of the College of Agriculture. With the increased appropriation, the Experiment Station needed added room, and the University has turned this wing over for the permanent use of the Station.

The west room on the first floor of the north wing will be used for the work in breeding. The east room on that floor is used by the Vegetable Pathologist. A laboratory and incubator room for the Vegetable Pathologist has been fitted up in the northeast corner of the basement.

The west room on the second floor is being used by the Entomologist and as a nucleus of a museum; and the east room on the second floor is occupied by the Pomologist. The former office of the Professor of Agriculture has been added to the general offices of the Experiment Station.

The former office of the chemist has been changed into a nitrogen laboratory, and the office of the veterinarian is being changed into a chemical laboratory. A hallway has been built across the rear of the former nitrogen laboratory and the west room in the wing so that the north and west entrances are now connected by hallway.

LIST OF BULLETINS PUBLISHED IN 1906.

125 Seed Inspection.

126 Field Experiments in 1905. Effect of Ration on Value of Manure.

127 Fertilizer Inspection.

128 Orchard Notes.

129 Feeding Stuff Inspection.

130 Poultry Experiments.

131 Indian Corn as Food for Man. Digestion Experiments with Chestnuts.

132 Plant Breeding in Relation to American Pomology.

133 Fertilizer Inspection.

135 Food Inspection: Law and Standards.

136 Food Inspection: Baking Powders, Spices and Vinegars.

137 Circulars, Finances, Meteorology, Index.

Maine Agricultural Experiment Station

BULLETIN No. 126. FEBRUARY, 1906.

FIELD EXPERIMENTS IN 1905.

EFFECT OF RATION ON VALUE OF MANURE.

This bulletin contains an account of field experiments on the Clark method of growing grass for hay; soil inoculation for legumes; alfalfa; Sal Bordeaux for potato blight; fertilizer experiments with peas and potatoes; and an account of an experiment studying the effect of the ration fed on the value of the manure.

Requests for bulletins should be addressed to the
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Orono, Maine.

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Walter Anderson	
Edith M. Patch	*Entomologist*
Bessie G. Tower	*Microscopist and Photographer*
Annie M. Snow	*Clerk and Stenographer*
Henry A. Millett	*Meteorological Observer and Janitor*

FIELD EXPERIMENTS IN 1905.

Chas. D. Woods and J. M. Bartlett.

The Station had about 40 acres in co-operative field experiments in 1905. The mid-summer was too dry in the northernmost part of the State for satisfactory experiments except with potatoes. The inoculation experiments for legumes were failures because of the poor quality of the cultures used. As Aroostook county was practically free from late potato blight, spraying and dusting experiments for this fungus did not give decisive results. The following experiments are here reported.

Clark method of growing grass for hay, page 25.
Soil inoculation for legumes, page 28.
Fertilizer experiments with garden peas, page 30.
Sal Bordeaux for potato blight, page 34.
Cooperative experiments with alfalfa, page 35.
Home mixed fertilizer experiments on potatoes, page 41.

Clark Method of Growing Grass for Hay.

Mr. Clark of Higganum, Conn., has for several years practiced intense cultivation for the production of hay with marked success. His method has been quite generally published in agricultural papers and this has led to the Station receiving many inquiries from correspondents as to the adaptability of this method to Maine conditions. Because of these inquiries the Station undertook to handle two acres of land as nearly as possible in accordance with Mr. Clark's published directions. A worn piece of grass land on rather heavy clay loam was selected for the purpose and plowed in the summer of 1903. This was harrowed about every fortnight with the Clark double action cutaway harrow. At the time the piece was plowed it was hoped that the frequent harrowing would break down the sod, and fine the soil so that a crop of winter rye could be grown. The turf proved too stubborn, however, and the ground was left without a covering during the winter. No fertilizer was applied in 1903.

The spring of 1904 was unusually wet and backward so that the first harrowing in 1904 was necessarily delayed until June 3. It was at this time harrowed in two directions with the double action cutaway harrow, and then made level with the Clark smoothing harrow. It was harrowed five times after this before it was seeded.

August 16, there was applied at the rate of 800 pounds per acre a fertilizer made from 500 pounds fine bone tankage, 100 pounds nitrate of soda, 300 pounds acid phosphate and 150 pounds of muriate of potash. The 800 pounds of this mixture carried about 27 pounds nitrogen, 75 pounds available phosphoric acid, 115 pounds total phosphoric acid and 75 pounds potash. The field was then again harrowed with the double action harrow and made true with the smoothing harrow, and seeded with timothy and red top at the rate of 14 quarts of each per acre. The seed was harrowed in with the Clark smoothing harrow (without the leveling board) and then rolled. There was an excellent catch and when the snow came the last of November the field was in good shape for the winter.

The following spring (1905) there were applied 300 pounds per acre of a fertilizer carrying about 20 pounds of nitrogen, 8 pounds available phosphoric acid, 22 pounds total phosphoric acid and 50 pounds potash.

As soon as the grass made much growth it was apparent that the piece was overseeded and the grass plants were badly crowding each other. As the result the grass was much finer than timothy and red top usually are. There was such a tangle of fine grasses at the bottom that it could not be cut clean with the mowing machine.

The field was mown the second week in July, at which time the timothy was a little past full bloom. The somewhat less than two acres yielded 6¼ tons of field cured hay. The second growth was not sufficient to warrant cutting. In our experience it is not practicable in the short season of growth to obtain two cuttings of the ordinary grasses. Clover can usually be depended upon to give two cuttings, but unless the first crop is cut too early for the best hay, timothy will give only one cutting a season in central and northern Maine.

The experiment clearly indicates the value of thorough preparation of the seed bed and liberal application of fertilizer for the production of grass. If half the quantity of seed had been used, the yield would probably have been greater and the hay of more desirable quality for horses.

The fertilizers used in growing this crop of 6 tons of hay cost about $40, and the seed and labor of preparation, seeding and harvesting cost about $37. In the next season and succeeding seasons the cost of fertilizers recommended by Mr. Clark and harvesting would be about $25 a year. If three successive crops equal to the first were obtained, the 18 tons of hay would be grown at a cost of a little more than $125. The hay would be worth according to the location of the farm in Maine from $8 to $12 a ton in the barn, or at an average price would bring about $180—a profit of $55 to pay the interest on the capital invested and taxes. With thinner seeding probably a larger crop would have been obtained. If the four tons per acre that Mr. Clark expects from the first cutting were obtained, the profits would be materially increased. It is to be noted that a very considerable part of the profit that Mr. Clark figures comes from the second crop that he can obtain in Connecticut with the 6 weeks longer growing season.

Although it is probable that thorough preparation and fertilization of the soil for hay will in the long run prove profitable even in Maine with its distance from markets, growing grass for the purpose of selling hay is probably not the best kind of agriculture for the average farmer in this State. In a few localities near to the larger cities hay farming may prove a profitable industry.

While thoroughly endorsing the general proposition that thorough preparation and high manuring of the land is essential to the highest success in grass raising, the Station does not recommend the adoption of the Clark method by Maine farmers, chiefly because it does not fit in with mixed farming and rotation of crops. The coarse products of the farm should be fed upon the farm and the manure returned to the land in order to maintain and increase fertility. Selling hay is selling fertility from the farm. Three tons of timothy and red top remove * about 69 pounds of nitrogen, 27 pounds of phosphoric acid and

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* Bulletin 107 of this Station, p. 137.

58 pounds potash that it will cost more than $18 to replace commercially.

The plan of a hay farm does not admit of rotation of crops. Rotations are very important in the proper and economical handling of land. For instance, if potatoes or corn are grown preceding grass, the land will be in equally good condition from fall plowing and once harrowing in the spring as from the frequent harrowings necessitated by summer seeding. In the rotation most of the cost of the preparation of the seed bed falls upon a money crop as potatoes, or corn, and not upon the next season's grass crop.

The seeding formula recommended by Mr. Clark does not contain clover. This is the most important forage plant that the Maine farmer can grow. It is rich in protein and is able to obtain its nitrogen from the air. While clover hay does not command as good price as that from red top and timothy, it can be grown at a less cost per ton and has a greater feeding value.

Soil Inoculation for Legumes from Artificial Cultures by the Help of Bacteria.

That legumes such as peas, clover, etc., can by the help of bacteria acquire atmospheric nitrogen through their roots has been a matter of common knowledge for 20 years. The bacteria produce enlargements upon the roots of the plants, which are called root nodules. Not all soils carry the proper organisms, but those deficient can be artificially inoculated. About ten years ago, under the name of Nitragin, commercial cultures were prepared in Germany for the purpose of inoculating sterile soils. This matter is discussed in considerable detail, together with certain experiments with nitragin, in the reports of this Station for 1897, 1898 and 1900. As a scientific curiosity nitragin was of great interest, but in practice it oftener failed to yield satisfactory results than to give them. The principles underlying the use of nitragin are of great practical importance, and many investigators are at work upon the problem. It was announced in an almost sensational article in the Century Magazine for October, 1904, that the U. S. Department of Agriculture had solved the problem of preparing active cultures in a convenient form for distribution. Later the department issued a bulletin *

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* **Bul. 71, Bureau of Plant Industry, U. S. Dept. Agr.**

announcing this discovery and giving the results of a large number of co-operative experiments which seemed to confirm the great claims made for these cultures. Because the soil in New England, where peas and clover have been grown for generations, is very generally inoculated with the nodule forming bacteria, the Station cautioned farmers against the purchase of cultures other than in an experimental way. It seems now that the method itself is unsatisfactory.

Cultures for ordinary legumes were obtained by this Station from the Department at Washington and from the Nitro-Culture Company of West Chester, Pa. The cultures furnished by the company were given to us and we have no reason to think but that they acted in entire good faith and that they believed the method and the cultures they were sending out to be all that was claimed for them. Experiments were carried out by this Station in the summer of 1905 on quite a number of farms in different parts of the State with peas, clover and alfalfa. The results were negative, and because as stated below the failures were due to the culture, the results are not given in detail. While taken by themselves they would not be sufficient to offset the large number of favorable reports printed by the department in the bulletin above cited, they accord with those obtained by many practical men in New England. Why they failed is explained by a very full and careful study made by the New York State Station * in which it is not only shown that the cultures sent out by the department and the commercial companies in 1905 were, so far as examined, worthless, but their studies discredit the method used in the manufacture of the cultures. Their conclusions are summarized as follows:

" I. During the past two years much interest has been shown in the inoculation of legumes with bacteria to enable the legumes to obtain nitrogen from the air.

II. These bacteria have been distributed in a dried condition upon cotton. Before being applied to the seeds the cotton is put into a solution of chemicals and the bacteria allowed to multiply.

III. These packages of treated cotton have had a wide sale at a high price—two dollars for a package sufficient to treat an acre—while the cost of production was less than ten cents.

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* Bul. 270, N. Y. State Expt. Sta.

IV. This bulletin gives the results of a bacteriological examination of 18 such packages of cotton.

V. These examinations made it very evident that the packages were worthless for practical purposes.

VI. Substantially identical results upon six of these packages were obtained in five separate laboratories.

VII. It was shown that the failure of these cultures was inherent in the method of their preparation rather than in any knavery of their producers.

. VII. While these results will explain the many failures from the use of cotton cultures they should not be undestood as being opposed to the idea of treating the seed of legumes with living bacteria." *

The principle of soil inoculation from cultures is all right, but the method of preparation and shipment practiced by the department and the commercial companies cannot be depended upon. Fortunately for Maine farmers there is probably but little to be gained by inoculating soil for our common leguminous crops such as clover, peas and beans. If one desires to grow alfalfa, soy beans, cow peas, or other leguminous plants that are not usually grown in the State, the inoculation by the application of soil from a field that has grown the desired legume with an abundance of root tubercles is the only sure way yet devised. This inoculation, by the transfer of soil carrying the organism, has never given negative results so far as the writers know. While it is to be hoped that the difficulties that made nitragin a failure, and the equally unsatisfactory results from nitro-cultures may be speedily overcome, the commercial cultures now in the market and any that are likely to be offered in 1906 are apparently valueless for practical purposes.

Fertilizer Experiment in Field Culture of Garden Peas.

In Northern Maine where potatoes are the chief money crop, a common rotation is to follow the potatoes with clover and mixed grasses, seeding with grain, sometimes wheat, but more commonly oats. In Woodland, near Caribou, in the northern part of Aroostook county, a pea canning industry has been introduced by Geo. T. Goodwin and Company. The peas can be used in the rotation in the place of grain. The culture is very

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* Bul. 270, N. Y. State Expt. Sta.

simple. The land is plowed in the late fall or early spring, and is treated the same as if grain is to be sown. The peas are planted with a grain drill, clover and mixed grasses if desired being sown at the same time. When the peas are in the right condition for canning, they are cut with a mowing machine and drawn to the factory where they are threshed, shelled and sorted by machinery. The yield in good seasons is about 2,500 pounds of shelled peas per acre, although 3,000 pounds is not an uncommon yield.

In 1905 the Station conducted two experiments on Mr. Goodwin's farms. While these were primarily intended as experiments upon inoculation of peas with artificial cultures, they served at the same time as partial fertilizer experiments. The account of the failure of the inoculation experiments due to the poor quality of the cultures both from the U. S. Department of Agriculture and the Nitro-Culture Company is given on page 28 and following. The report of the fertilizer experiments follows.

In growing potatoes only high grade fertilizers carrying 3 to 4 per cent of nitrogen are employed. Because of the readiness with which this class of fertilizers are obtained they are also quite commonly used for pea growing. When the soil is stocked with the proper organisms, peas, as other legumes, can obtain all, or practically all of their nitrogen from the free nitrogen of the air. The bacteria which enable the plants to do this are more active when the supply of combined nitrogen is limited. Thus it happens that when a fertilizer that furnishes all the nitrogen needed for a given crop of legumes is used, the plants avail themselves of this ready combined nitrogen and do not obtain any considerable amount from the air. In the experiments here reported fertilizers low in nitrogen were used.

EXPERIMENT AT HOME FARM.

The field used for this experiment was situated on a rather moist side hill with a slope to the south. The land was in a good state of cultivation and the greater part of it was planted to peas in 1904, while the rest was in grass. A section of four acres which appeared to be uniform in condition was selected for the experiment and divided into plots of one acre each. The division was so made that each plot covered an equal portion of the section which was in grass last season. The whole field received a dressing of pea vines from the factory which were plowed under, also the following amounts of fertilizing materials were added to each plot.

Plot 1—400 lbs. acid phosphate, 250 lbs. muriate of potash.

Plots 2, 3, and 4—100 lbs. dried blood, 400 lbs. acid phosphate, 250 lbs. muriate of potash.

On May 23rd Alaska peas were planted with a grain drill at the rate of 2½ bushels to the acre. Those put on plot 1 were inoculated with the Nitro-Culture Company's culture, and those on plot 2 received no treatment. The seed used on plot 3 was treated with the U. S. Department of Agriculture's culture and that of plot 4 was not treated with any culture.

The field was visited June 27 and at that time the peas were about 8 inches high, of good color and appeared to be in a thrifty condition. The roots of some plants on each plot were examined and in every instance the nitrogen collecting bacteria nodules were found to be present. This shows, as was to be expected, that the field was thoroughly stocked with the nodule forming bacteria. There was no noticeable difference in the different plots either in size and thriftiness or in the number or character of the root nodules.

The field was visited again July 28th, but the weeds had then made such progress that it was not possible to make any comparisons of the different plots and the peas were nearly ripe enough to harvest.

On July 29 a part of plot No. 1 was harvested and on the 31st the harvesting of this plot was completed together with plots 2 and 3,—three acres per day being about all the factory could take care of. August 1st plot No. 4 was taken to the factory.

The yields of green peas after being threshed and screened are shown in the following table.

Plot 1. Phosphoric acid and potash, 1,747 pounds.
Plot 2. Nitrogen, phosphoric acid and potash, 1,388 pounds.
Plot 3. Nitrogen, phosphoric acid and potash, 1,307 pounds.
Plot 4. Nitrogen, phosphoric acid and potash, 1,431 pounds.

All of the yields are small, not much more than two-thirds of a crop being secured on account of the very dry season. The larger yield on plot 1 was probably due to some cause not directly connected with the experiment. It is hardly to be thought that the presence of the small amount of nitrogen used on plots, 2, 3 and 4 could have any relation to the diminished yield. The results show that this small amount of nitrogen was at least unnecessary.

EXPERIMENT ON SECOND FARM.

The experiment made at this farm was on a piece of land which had been in grass for several years and was in a rather low state of cultivation. It was not known to have ever been planted to peas and for this reason was considered an excellent piece on which to test the effect of the nitro-culture material. Four acres of the field was measured off and divided into plots of one acre each. After the sod was turned over and the land thoroughly harrowed it was dressed with 700 lbs. to the acre of the following mixture: nitrate of soda, 50 lbs.; acid phosphate 400 lbs.; muriate of potash 250 lbs. It will be noticed that a very light application of nitrogen was made, the idea being to apply just enough in the most available form for the immediate use of the plants up to the time when the nitrogen collecting bacteria could begin to work.

On May 25 the field was planted to Alaska peas. The seed used on two of the plots was inoculated and on two of them it was not treated.

The field was visited on June 27th and at this time the peas were about 6 inches high with a very even stand over the whole piece. The plants were rather light colored and no nodules could be found on the roots. On July 7th the field was again visited. The plants were found to be 12 to 15 inches high, in blossom and growing finely. The roots were examined for nodules and all the larger plants were found to be abundantly supplied with them, but very few were found upon the roots of the smaller plants and those that were found were down low on the smaller roots. As far as could be observed at this time the nodules were no more plentiful in the plots that had received the culture than on the blanks.

No rain fell during July and this field suffered greatly from the drouth, resulting in the premature ripening of the peas and a yield of less than half a crop. The experiment would not have been reported except for the interesting fact that root nodules formed abundantly on a large part of the plants on two of the four plots. It happened that one of these plots received inoculated seed and the other did not. The two other plots, one inoculated and one not, had less root nodules. So far as known peas had never been grown on this or near by land. The organism must have been present in the soil or else upon the seed used.

The results of these two experiments are not satisfactory because of the exceedingly sharp drouth, but they seem to indicate that most soils that have been long cultivated are well stocked with the nodule forming bacteria and that a fertilizer containing only the mineral constituents, or at the most a little added nitrate nitrogen, will supply all the needed plant food for a good crop of peas.

SAL BORDEAUX FOR POTATO BLIGHT.

In 1904 * experiments were made with dry Bordeaux mixture as a preventive of late blight that showed the dry Bordeaux to be inferior as fungicide and preventive to the wet Bordeaux mixture when applied as a fine spray. The Dust Sprayer Manufacturing Company of Kansas City, Mo., prepare a fine powder that they have named Sal Bordeaux. It consists of equal parts by weight of exceedingly finely ground copper sulphate and lime. This is applied as a dust and the theory is that as soon as this dust becomes moist, from dew or otherwie, the regular Bordeaux mixture in concentrated form is produced at once upon the foliage.

Five plots of one acre each were used in an experiment on the farm of Mr. John Watson of Houlton in comparing the effect of dusting potato vines with Sal Bordeaux and spraying with regular Bordeaux mixture. The potatoes were all Green Mountain. A high grade fertilizer (Watson's Improved) was used at the rate of 1,250 pounds per acre. The different plots were dusted and sprayed on the same days as follows, July 5, July 15, July 25, (followed by showers), August 2, August 10, and August 22.

The Sal Bordeaux was applied at the rate of 10 pounds, 6 pounds and 3 pounds per acre. It was diluted with lime in each case and until the danger of bugs was over, Paris Green was used at the rate of half a pound per acre. On July 31 all the dusted plots were also sprayed with one pound Paris Green and two pounds of lime per acre, as these plots were pretty badly infested with the potato beetle. Either the dusted poison was not as effective as that applied wet, or the showers following the

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* Bul. 112, Maine Agricultural Experiment Station p. 6.

application of July 25 washed off the dusted more than it did the sprayed. Whatever the explanation, the dusted rows were infested and the sprayed rows were not.

The Sal Bordeaux was applied with a small hand "cyclone" duster, two rows being treated at a time. The nozzle of the machine was so directed that the cloud of dust striking the row nearest passed through it or was carried by the wind to the adjoining row. Of course the nearest row received the more powder and was more thoroughly dusted, but the dust was plainly visible on the second row and some reached rows beyond. With this apparatus one man could dust an acre an hour.

There was no blight on the whole piece and but little blight in the county in 1905, so that the results are not regarded as conclusive. The yields were practically the same on the 5 plots, running from 100 to 102 barrels (275 to 281 bushels) of merchantable potatoes.

It is planned to repeat the experiment in 1906 and to use a power duster devised for potatoes.

Co-operative Experiments With Alfalfa.

The Station began experimenting with alfalfa in 1903, but because of the lateness of sowing, poor preparation of soil, and other unfavorable conditions, that season's sowings gave no decisive results.

EXPERIMENTS BEGUN IN 1904.

The alfalfa seed (9,452, from Turkestan) used in 1904 was furnished by the U. S. Department of Agriculture. "This seed was secured by Mr. E. A. Bessey in the fall of 1902 at Karabulak, 25 miles north of Chimkent, Turkestan. This part of Turkestan is subject to extremely cold weather in winter and great heat in summer and the alfalfa seed raised there is considered to be the best raised in Turkestan. This seed has been treated with the alfalfa tubercles and should be in condition to give the best results."

At Princeton.

About one-half acre was sown May, 1904, on the farm of Mr. J. W. Edgerly, in Princeton. The land sloped so as to afford good natural surface drainage. The soil was rather light, and unusually deep and yields 25 to 30 bushels of wheat to the acre. The piece was plowed in the fall of 1904, harrowed, smoothed and seeded with Turkestan alfalfa. It was planted in drills 14 inches apart so as to give the plants plenty of room, in the hope that they could be used to grow seed. Two hand seed drills were used. One of the machines was set too close so that only every other row had a good stand. The poorly seeded rows were reseeded in June. The piece was kept free from weeds by the use of the hand wheel hoe and hand work. The piece was cut once in the mid summer of 1904. It went into the winter in good shape, and came through the winter in fine condition. In 1905 this piece presented the same peculiarities found at Houlton and referred to later. In some places it was dark green in color and very vigorous, and at cutting (July 21, 1905) was 3 feet high. In other places the alfalfa plants were short and yellow. Because of the very uneven growth this experiment has been abandoned.

At Houlton.

This experiment includes two and a half acres of land on the farm of Mr. John Watson. The land slopes to the south and east, and yielded over 100 barrels of potatoes to the acre in 1903. Judging from the yeild of potatoes the soil is quite uniformly productive. The whole field was fertilized with a high grade commercial fertilizer. One-half of the field was limed at the rate of one ton per acre, and one-fourth of the field was liberally dressed with hard wood ashes. The four plots were arranged so as to have lime, ashes, and no alkali on each plot. Plots 1 and 2 were seeded in May, 1904, and plots 3 and 4 in August of that year. Plots 1 and 4 were sown broadcast with a Massey seeder; plots 2 and 3 were drilled with a hand seeder in drills 14 inches apart. Plots 3 and 4 were harrowed frequently with a disc harrow up to the time of seeding in August. On the drilled part the weeds were kept down by the use of the hand wheel hoe and hand weeding. On the broadcast plots the weeds were kept down by mowing. Plot 2 was mown in July. The spring sown plots made a good growth, and went into the winter in good condition. Plots 3 and 4 were so late sown that the plants made but little growth before cold weather.

Treatment in 1905. The spring seeded broadcast plot (1) was badly choked with weeds. It is doubtful if many alfalfa plants were winter killed. Because of the weeds, the seeding of 1904 was abandoned and the plot was plowed, summer fallowed with frequent harrowing and it is planned to re-seed in 1906. The spring drilled plot (2) came through the winter without loss. The following notes were taken May 31. The plot presents very marked peculiarities. All over it are occasional plants that are very dark colored and exceedingly vigorous. These vigorous plants are the most numerous on the part treated with ashes; less numerous on that with lime; and quite scattered on the part that had neither lime nor ashes. All over the piece there are plants of sickly appearance, seemingly nitrogen starved. These, of course are most numerous on the plots that have the least of the very vigorous plants. Specimens of both the luxuriant and poor alfalfa were dug and the roots were found to be about equally stocked with root tubercles. At this date, May 31, the best plants were about 16 inches high. The poor were about 6 inches high.

The field was tested in a number of different places with litmus paper and found to be acid. As the ashes were applied with a manure spreader they would be somewhat unevenly distributed, and it might be that the places where the plants were the most vigorous received a more liberal application and that the acid was neutralized in these spots. This explanation would not apply as well to the lime which was applied by hand in finely powdered form, and would not at all explain the presence of clumps of thrifty plants on the part that had no alkali. The alfalfa was cut in July. Because of the drought in July and August the plants made but little growth until September. They went into the winter in good condition.

Plots 3 and 4 (August seeded) did not come through the winter in good shape, and the 1904 seeding was abandoned. The piece was thoroughly harrowed, smoothed and seeded May 31, 1905, with Montana grown alfalfa seed at the rate of 25 pounds per acre. This seed was applied broadcast with the Massey seeder. No fertilizer was applied this year. The eastern part of the piece, rather more than half an acre, was seeded with " scratched seed,"—i. e. seed that had been passed through a machine that scratched the seed coats, with the thought of thus hastening germination. The remainder of the piece was seeded with unscratched seed. It germinated well, with no noticeable difference between the scratched and the unscratched seed. Because of the very dry July and August the plants made but little growth before cold weather came on.

At Fort Fairfield.

One piece of about half an acre was seeded broadcast on the farm of Mr. Clarence Powers near Maple Grove Station. This had borne potatoes the preceding season and was thought to be a very clean piece of land. It was found however to be so completely stocked with weeds that the alfalfa had very little chance. A few plants struggled through the summer, but the experiment was abandoned.

In co-operation with Dr. F. M. Perry, about one-half acre was sown near the Fort Fairfield station. This was located on the first river terrace, was light soil and naturally well drained. A liberal application of lime and of a high grade fertilizer was made. The piece was planted in drills 14 inches apart and kept free from weeds with a wheel hoe and hand weeding. A good stand was obtained, the plants grew well, were cut in July, made good second growth and went into the winter in good condition. The plants came through the winter in good shape. The stand was good and for the most part the plants were vigorous. The crop was cut in July, 1905. Because of the drouth but little second growth was made and the plants did not go into the winter of 1905-6 in as good condition as the preceding year.

EXPERIMENTS BEGUN IN 1905.

The U. S. Department of Agriculture placed at the disposal of the Station for distribution among experimenters in Maine, 500 pounds of Montana grown alfalfa seed. The following is quoted from a department letter relative to this seed. "This seed contains quite a percentage of hard seeds, i. e. seeds that will not germinate in the ordinary time and we are now considering the advisability of putting all this seed through a seed scratching machine to see if that will not improve its germinating power. * * * The Montana grown seed we propose furnishing you shows 53.5 per cent of sprouts in 3 days; probably a 7 or 8 day test will bring the germination up to 65 or 70.

At the expiration of that time there will undoubtedly be at least 25 per cent of hard seeds. This alfalfa seed has all been inoculated."

Of that sent, 400 pounds was unscratched and 100 pounds scratched. In no case did the experimenters report that there was any perceptible difference in the field germination of the scratched and the unscratched seed.

A note was put into the agricultural papers of the State that we had a limited amount of alfalfa seed that we would send to any Maine farmer applying for it on condition that the cultural instructions would be followed and results reported to the Station. A very large number of requests were received, many more than we had seed for. Seed was sent to the first 80 that applied with the following cultural suggestions.

Alfalfa—Directions for Culture.

Selection of Soil. Good deep mellow corn or potato land is usually a suitable soil for alfalfa. Good drainage is necessary, as the plants are quickly killed by excess of water in the soil or on the surface. Water must not be allowed to stand on a field of alfalfa more than forty-eight hours at a time, for if the ground becomes saturated with water and is allowed to remain so for any considerable length of time the plants will be drowned out and the roots will decay. Neither will alfalfa succeed if rock, stiff clay, or other impervious subsoil lies too near the surface. Although alfalfa requires good drainage, it also requires a fairly constant water supply and is likely to suffer from drouth on deep, sandy soil.

Preparation of the Soil. The seed is best sown in the early spring on land that was fallowed the preceding summer and left bare during the winter. The summer fallowing, if properly done, will eradicate all weed seeds that were near enough to the surface to germinate. It is well-nigh impossible to start alfalfa if the soil is not in fertile condition. The land should be put in excellent tilth and be in good heart before any attempt is made to sow alfalfa.

Sowing the Seed. The seed should be sown in early spring. For production of hay, alfalfa may be sown either broadcast or drilled. If practicable, drill the seed, as weeds can be more readily kept down. If sown broadcast, 20 pounds are used to the acre. In drills six or seven inches apart, 15 pounds will be sufficient. This seed should not be sown with any nurse-crop, and the seed should not be drilled deeper than an inch or an inch and a half. On moist soils much less than this is better.

Inoculation for Root Tubercles. The Montana grown alfalfa seed sent herewith has been inoculated with the bacteria that produce root tubercles and enable the plant to acquire nitrogen from the air. Hence soil inoculation is not necessary.

Treatment the First Season. Drills should be cultivated frequently enough to keep down weeds until the alfalfa has a good start. *Young alfalfa is unable to compete with weeds.* It is better for the young alfalfa to mow it frequently, setting the cutter bar rather high, the idea being to cut back the young plants, so that they will branch freely. Frequent cutting also discourages weeds. It should not be cut much later than August 15, in order to leave a good winter protection of vines.

Notes Wanted. Kind of soil and previous treatment.

Date of sowing and whether in drills or broadcast.

Notes and appearance during the season.

Dates of cutting.

Length of vines when ground freezes.

The last of October (1905) blanks for reports were sent to the experimenters and replies were received from 61. Of these 61, less than half succeeded in getting a good stand. Choking out by weeds and the damage from drouth were the two most common causes of failure. Twenty-five of the experimenters report the plants as in good condition for the winter. Another season these 25 plots will be looked after and if the results are instructive, either negatively or positively, they will be reported.

NOTES AND INFERENCES.

Alfalfa growing has been tried many times in the State and while there are no alfalfa fields of any considerable size in Maine, there are a few people who have had partial success in growing the crop. At Bath there are alfalfa plants that have been established for more than ten years. The roots of a specimen sent to the Station last May were more than a half inch through at the crown. On the fine fibrous roots there were a few root nodules. A Topsham farmer has been experimenting with alfalfa for six or seven years and in a letter written last

May says: "Although the stand is not perfect by any means, I think I may claim without boasting that today I have the best plot of ¼ acre of alfalfa in Maine." There are other small pieces in Brunswick that are partial successes. Rust which has proven so destructive in Vermont and Northern New York has not been reported in Maine. Weeds are apparently the greatest menace of any one thing to successful alfalfa growing in the State. A representative of the U. S. Department of Agriculture, who has made two trips through New England studying the alfalfa growing, is of the opinion that the dying out of alfalfa may "possibly be from winter killing but more probably by being run out by native grasses."

Unfortunately, as noticed on page 29, the cultures that were sent out last year for inoculating soils proved unreliable and cannot be counted upon for soil inoculation. Any one desiring to experiment with alfalfa will therefore have to grow it without inoculating the soil, or will have to obtain soil from a field where alfalfa has been grown and produced an abundance of root nodules. In order to be of value to Maine agriculture a good stand must be obtained and the stand must be able to continue not one, but several years. The Station does not advise anyone in this State to grow alfalfa at present except in an experimental way. To those who have land that seems to be suited to alfalfa and have the time and patience to thoroughly care for the crop, the Station will gladly lend assistance in any way that it can. That alfalfa would be a valuable addition to our forage crops needs no demonstration. If the difficuties which thus far have prevented its successful culture can be surmounted, it will more than recompense the cost of the many hundreds of trials that have been given this plant in Maine during the past 25 years.

Home Mixed Fertilizers for Potatoes.

There are sold in Maine a large number (about 40) brands of fertilizers that contain the word "potato" in their name. In the case of more than half of these brands there seems to be no reason, other than the attractiveness of the word, to call them potato fertilizers. More than half of them have the composition of general purpose goods, carying about 3 per cent of nitrogen, 8 per cent of phosphoric acid, and 3 per cent of potash. The same formulas could, with equal propriety, be called corn fertilizers. A few are seriously intended as special formulas for potatoes. These goods carry proportionately more potash and less phosphoric acid. Such brands carry from 3 to 4 per cent nitrogen, about 6 per cent available phosphoric acid and 5, 8 or even 10 or more per cent of potash.

In 1904 experiments with home mixed fertilizers in comparison with standard high grade mixed goods were made on two farms in the town of Houlton and also in Fort Fairfield. The materials were bought at one time and were all mixed at Houlton. The formula was:—Portland Rendering Company's (rescreened) tankage 420 pounds; acid phosphate 400 pounds; cottonseed meal 200 pounds; sulphate of potash 200 pounds; and nitrate of soda 100 pounds. Analysis showed the mixed goods to have the following composition: Water soluble nitrogen 1.37 per cent; availabe nitrogen 2.72 per cent; total nitrogen 4.09 per cent; available phosphoric acid 7.01 per cent; total phosphoric acid 9.87 per cent; and potash 7.61 per cent.

The details of these experiments are given in Bulletin 112 of this Station. With the exception of one field of early planted potatoes the results were all in favor of the commercial brands.

Average yield of merchantable potatoes grown on home mixed fertilizers in 1904 compared with commercial potato fertilizers.

Owner of Farm.	Acres in experiment.	Barrels of Potatoes.	
		Home mixed fertilizer.	Commercial fertilizer.
John Watson, Houlton	8	107	120
W. S. Blake, Houlton	8	106	110
C. A. Powers, Fort Fairfield	4	119	119
R. S. Hoyt, Fort Fairfield	6	109	114

This smaller yield was explained as follows: "The tops kept greener in color during the last half of the growing season with the home mixture. September 1, there was a severe frost all over Northern Maine. The late potatoes grown upon the home mixture had greener and more succulent vines than those upon the standard fertilizers and in consequence were damaged much more by the frost. In fact, the vines of the late planted potatoes on the home mixed goods were practically killed at this time, while the same varieties planted at the same time upon the standard potato fertilizer continued to grow after this frost. As a result, the potatoes were larger and better ripened with these than upon the home mixed plots. For quick maturing, the home mixed goods apparently carried too much slowly available nitrogen and too little available phosphoric acid."

In 1905 three formulas were compared with one commercial potato fertilizer. The formulas used were as follows:

Home mixed formulas used for potatoes in 1905.

Ingredients.	NUMBER OF FORMULA.		
	2	3	3A
	pounds.	pounds.	pounds.
Nitrate of soda	200	100	100
Screened tankage	200	200	200
Dried blood	100	....	....
Acid phosphate	500	300	500
Sulphate of potash	200	200	200

Percentage composition of fertilizer used in 1905.

	Nitrogen.	Phosphoric Acid.		Potash.
		Available.	Total.	
	%	%	%	%
Formula No. 2	4.7	6.7	8.5	8.3
Formula No. 3	3.4	6.8	9.2	12.5
Formula No. 3A	2.7	8.0	10.2	10.0
Watson's Improved	3.0	6.0	7.0	5.0

Arrangement of acre plots, pounds of fertilizer and constituents applied and yield of potatoes.

Number of plot.	Fertilizer Used.		Pounds per Acre in Fertilizer Used.				Yield of Potatoes.	
	Kind.	Amount.	Nitrogen.	Phosphoric Acid.		Potash.	Merchantable.	Small.
				Available.	Total.			
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bbls.	Bbls.
1	Watson's Improved	1,600	48	96	112	80	101	5
2	Home mixed 2	1,200	56	80	102	100	88	6
3	Watson's Improved	1,250	37	75	87	62	71	11
4	Home mixed 3	1,000	34	70	92	125	72½	7
5	Watson's Improved	1,250	37	75	87	62	93	5½
6	Home mixed 3 A	1,000	27	80	102	100	83	2½
7	Watson's Improved	1,250	37	75	87	62	87	3
8	Home mixed 2	1,200	56	80	102	100	87	5
9	Watson's Improved	1,250	37	75	87	62	90	4½
10	Home mixed 3	1,000	34	70	92	125	89	4
11	Watson's Improved	1,250	37	75	87	62	99	4
12	Home mixed 3 A	1,000	27	80	102	100	99	4½
13	Watson's Improved	1,250	37	75	87	62	106	5

The irregularities of the yields on the first 4 plots can be explained by the differences in the character of the soil. Comparing the yields on the home mixed plots with the average of the commercial fertilizer plots either side of the home mixed plots the following results are obtained:

Formula No. 2, 87 barrels; Watson's Improved, 87 barrels.
Formula No. 3, 81 barrels; Watson's Improved, 88 barrels.
Formula No. 3A, 91 barrels; Watson's Improved, 96 barrels.

It will be noted that the results on the whole are again lower with home mixed goods than with the commercial fertilizer. The results are not consistent, however, with each other, and no conclusive interpretation of the results are apparent. It is planned to continue the comparisons another season.

THE EFFECT OF THE RATION ON THE VALUE OF THE MANURE.

J. M. Bartlett.

In digestion experiments with steers, where both the feces and the urine were saved, potash and phosphoric acid determinations as well as nitrogen were made in order that the fertilizing value of the manure from the different rations could be compared. It will be noticed that no figures are given in the table on page 46 for the percentages of potash found in the urine. The determinations were made, but owing to a probable error in calculating the results from the dry to the fresh bases, which at this time cannot be corrected, they are omitted. Other experiments show that the potash of the food is practically all given off in the excretions, so the figures given for potash in the urine are obtained by subtracting the potash of the feces from the total amount taken in the food.

Only traces of phosphoric acid were found in the urine. In the first experiment with hay alone, more nitrogen was found in the excretions than was taken in the food. This discrepancy was probably due to insufficient nitrogen in the ration to maintain the animals and they lost flesh, excreting some body nitrogen. Therefore the feces from this ration relatively contains more nitrogen and value higher than they should, for it is evident that the animals could not continue for any length of time to give off more nitrogen than they received.

The results are given in the tables which follow.

The first table on page 46 gives the weights of food eaten and feces and urine excreted for each animal for the five day that the experiment occupied and the second table contains the percentages of fertilizing ingredients in both food and excreta.

The tables on page 47 contain the amount of fertilizing ingredients excreted by each animal and the total amount of fertilizing ingredients in the food, feces and urine, also the percentages excreted.

The total weight of food eaten, and feces and urine excreted by each steer for five days.

	Steer's number.	Hay.	Grain.	Feces.	Urine.
		Grams.	Grams.	Grams.	Grams.
Hay alone	1	18143	....	7159	16964
Hay alone	2	18143	....	7133	17372
Hay and spring wheat bran	1	15875	6804	8786	15784
Hay and spring wheat bran	2	15875	6804	8488	17826
Hay and winter wheat bran	1	15875	6804	8256	11130
Hay and winter wheat bran	2	15875	6804	8256	16919
Hay and cottonseed meal	1	18143	4536	8501	13970
Hay and cottonseed meal	2	18143	4536	8501	16645

Percentage of fertilizing material in the food, feces and urine.

	Nitrogen.		Phosphoric acid.	Potash.
FOOD.	%	%	%	%
Hay	0.79	....	0.33	1.49
Spring wheat bran	2.66	....	3.19	1.79
Winter wheat bran	2.58	....	2.86	1.46
Cottonseed meal	7.48	....	3.10	1.94
FECES AND URINE.	Feces.	Urine.	Feces.	Feces.
Hay alone .... Steer 1	1.34	0.59	0.58	0.59
Hay alone .... Steer 2	1.25	0.59	0.64	0.48
Hay and spring wheat bran .... Steer 1	1.47	0.97	2.83	1.69
Hay and spring wheat bran .... Steer 2	1.51	0.86	2.49	1.17
Hay and winter wheat bran .... Steer 1	1.45	1.16	2.32	1.74
Hay and winter wheat bran .... Steer 2	1.48	0.75	2.26	1.29
Hay and cottonseed .... Steer 1	1.80	1.87	1.94	0.98
Hay and cottonseed .... Steer 2	1.81	1.48	1.57	1.04

Fertilizing elements excreted by each steer for five days.

	Nitrogen.		Phosphoric acid—solid.	Potash.	
	Solid.	Urine.		Solid.	Urine.
	Grams.	Grams.	Grams.	Grams.	Grams.
Hay alone..................Steer 1	95.9	100.1	41.5	42.2	228.1
Hay alone..................Steer 2	89.2	102.5	45.6	34.2	236.1
Hay and spring wheat bran, Steer 1	129.1	153.1	248.6	148.5	209.9
Hay and springwheat bran, Steer 2	128.2	153.3	211.3	99.3	259.1
Hay and winter wheat bran, Steer 1	119.7	129.1	191.5	143.7	192.2
Hay and winter wheat bran, Steer 2	122.2	126.9	186.6	106.5	229.4
Hay and cottonseed meal...Steer 1	153.0	261.3	164.9	83.3	275.0
Hay and cottonseed meal...Steer 2	154.6	246.5	134.1	88.8	269.5

Fertilizing elements in food and the average amount excreted for each experiment. Five days.

	Amount in Food.			Amount Excreted.			Per Cent Excreted.	
	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.
	Gms.	Gms.	Gms.	Gms.	Gms.	Gms.	%	%
Hay alone..............................	143.3	59.9	270.3	193.9	43.6	270.3	135.3	71.8
Hay and spring wheat bran.........	306.4	269.6	358.4	276.4	229.2	358.4	89.2	85.3
Hay and winter wheat bran.........	300.9	243.3	335.9	254.0	189.1	335.9	84.4	77.7
Hay and cottonseed meal, 8 to 2....	482.6	200.5	358.3	407.7	149.5	358.3	84.7	74.6

In the table that follows there are given the values of the fertilizing constituents of the total excreta in each experiment and of the resulting manure from 100 pounds of each feed, provided both the solid and liquid excreta are saved. In the calculations the values for the same materials assumed for commercial fertilizers in 1904 are used.

The money value of the fertilizing elements excreted for each experiment.

	Nitrogen.	Phosphoric acid.	Potash.	Total value.
	Cents.	Cents.	Cents.	Cents.
Hay alone	5.36	.39	2.98	8.63
Hay and spring wheat bran	10.40	2.03	3.95	16.38
Hay and winter wheat bran	9.52	1.67	3.70	14.89
Hay and cottonseed meal	15.30	1.32	3.95	20.57
100 lbs. hay	13.50	.98	7.45	21.93
100 lbs. spring wheat bran	37.80	11.91	8.93	58.64
100 lbs. winter wheat bran	31.90	8.85	7.27	48.02
100 lbs. cottonseed meal	99.40	9.30	9.60	118.30

The figures given in the above tables furnish results which are instructive and may be of considerable value to the farmer. In feeding animals or buying feeds, one is very likely to consider only the feeding or flesh forming value of the feeds, not taking into consideration their effect on the value of the manure produced. When more manure is needed than can be made and the supply has to be frequently supplemented with commercial fertilizers, the purchase of high priced feeds rich in fertilizing material is oftentimes the most economical on account of the increased value of the manure they make. In the preceding table it will be seen that for every 100 pounds of cottonseed meal fed, about $1.18 worth of fertilizing material was given off in the excreta when everything is saved.

Another important fact can be learned from the table on page 47 which shows the amount of fertilizing elements in both the solid and liquid excrements. It will be noticed that the larger part of the nitrogen, the most expensive element, and potash are given off in the urine, hence the importance of saving all of this most valuable part of the manure. Not only are other elements found in large quantities in the liquid, but they are in much more available form than in the solid.